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DEVICE FOR TREATMENT OF PATIENTS WITH DISTURBED POSTURE  
AND MOTOR ACTIVITY

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Technical Field

5 The present invention relates generally to devices for nonsurgical (conservative) treatment of the locomotor apparatus (locomotorium) in various neuropathies, and more specifically to a device for treatment of patients with disturbed posture and motor activity.

10 The invention can find most utility when used for treatment of infantile cerebral paralysis.

The invention is likewise applicable in cerebrovascular accidents involving motor disturbances and traumatic lesions of the spinal cord.

15 Furthermore, the invention can be applied for correction of patient's posture (attitude), as well as for sports exercises.

Background Art

20 At present the number of neuropathic patients suffering from affection of the locomotor functions becomes immense, while infantile cerebral paralysis, in particular, tends to rise, for a number of reasons, in many countries throughout the world.

25 Treatment of motor functions in infantile cerebral paralysis patients becomes urgent due to both, the number of patients and imperfection of the treatment method available.

The present state of the medical art knows a number of methods and devices for treatment of patients with disturbed posture and motor activity.

30 One state-of-the-art method for treatment of patients with disturbed posture and motor activity (cf. "Surgical correction of posture and walking in infantile cerebral paralysis" by A.M. Zhuravlev et al., 1986, Aistat Publishers, Yerevan, pp. 90-91 (in Russian) is known to  
35 comprise stage-by-stage plastering, followed by rigidly fixing the position of the limb and trunk with an altered

posture. A disadvantage inherent in said method resides in a restricted motor activity (immobility) of a patient, which might result in amyotrophy, spastic phenomena, and increased hypertensive syndrome due to enhanced pathological muscular synergies.

Furthermore, another ~~advantage~~ <sup>disadvantage</sup> of said object is a prolonged treatment period, that is, from 4 to 6 months.

One state-of-the-art device for treatment of patients with disturbed posture and motor activity is known (FR, A, 2,120,500) to appear as overalls into which flexible inflatable tubes are inserted to impart rigidity thereto.

A disadvantage inherent in said device is the fact that it is aimed at maintaining the patient's body in a definite position, whereby the field of application of said device is extremely restricted. In addition, said device fails to solve the problem of muscular exercises of a patient, which might lead to profound dysfunction of the muscular system.

Another device for treatment of patients with disturbed posture and motor activity is known (FR, A, 2,252,836) to comprise two blades interposed between the patient's thighs, each of said blades being fixed to a respective thigh, and a mechanical system connected to the blades.

The device under discussion suffers from the disadvantage that it can correct only a wrong position of the thighs, knee joints, and feet. In addition, said device is bulky and therefore its application with therapeutic purposes is very questionable.

One more device for treatment of patients with disturbed posture and motor activity is known (SU, A, 1,528,483) to comprise a thoracic, pelvic, and pedal support, and fixing elements to interconnect the aforesaid supports to one another.

The fixing elements are shaped as telescopic stands interconnecting the pedal supports with the pelvic one and with a bar, one of whose ends is rigidly coupled to the pelvic support. The bar carries a roller reciprocatingly mounted thereon and rigidly linked to the thoracic support. Two arms are rigidly connected to the pelvic support, the free ends of said arms being connected to springs movably mounted on the telescopic stands.

With the patient's body in the erect position the roller provides a light reclining effect produced on the entire vertebral column, while the thoracic support provides rest for the upper trunk portion. With an inclined position of the trunk the roller rides over the bar depending on the angle of inclination so as to assume an optimum position, and the springs impart an effort to the bar. Thus, the weight of the inclined trunk portion is compensated for and the muscular system and vertebral column are released from load.

A disadvantage of the abovesaid device consists in that it is intended for treatment of the vertebral column only by releasing it from load. In addition, use of said device might result in restricted mobility of a patient followed by amyotrophy and affected activity of the antigravity muscles. Above all the treatment process with the use of said device is too prolonged.

#### Disclosure of the Invention

It is an essential object of the present invention to provide a physiologically normal stereotype of posture and movements.

The present invention has for its principal object to provide a device for treatment of patients with disturbed posture and motor activity, wherein the fixing elements interconnecting the supports have such a construction that enables the patient's trunk and limbs to be fixed in a position approximating normal physiological parameters, while maintaining a possibility of performing

energy-loaded movements by the patient, with the amplitude of said movements characteristic of a given patient.

The foregoing object is accomplished due to the fact that in a device for treatment of patients with  
5 disturbed posture and motor activity, comprising pelvic and pedal supports placed on patient's trunk and limbs and interconnected by fixing elements, according to the invention, the fixing elements are shaped as elastic tie-members arranged on the patient's body surface so as  
10 to follow anatomical arrangement of the skeletal muscles, each of the tie-members being connected to two supports.

The proposed device is instrumental in fixation of joints in a required position and to establish a moment of force effecting flexion, extension, rotation, adduction,  
15 and abduction of the patient's limbs and trunk.

According to a preferred embodiment of the invention, the device comprises additional shoulder, knee, elbow, finger, and toe supports.

Such an embodiment of the invention makes it possible  
20 to fix practically all the joints of patient's trunk and limbs in a preset position and enables the patient to perform energy-loaded movements with amplitudes attainable by a given patient.

It is quite reasonable that the device comprises tension  
25 adjusters of the elastic tie-members, each of such adjusters being interposed between the respective tie-member and one of the supports.

Provision of the tension adjusters in the device enables one to vary and individually select the force  
30 of action exerted by the tie-members on the musculoskeletal system, thus adding to the efficacy of treatment.

Use of the proposed device makes it possible to utilize functional (active) correction of the pathologic positions of the trunk and limbs instead of static (passive) corrections thereof, rearrange the previous pathologic stereotype  
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of the posture and movements in the central and peripheral nervous systems, potentiate destruction of the old pathologic complex of reflexes that has been established in the course of the disease, and create the new control and con-  
5 duction system through the intermediary of the defense structures of the brain. In addition, the effect produced by the device on patient's organism consists in that the correction of the locomotorium and energy loading of move-  
10 result in activation of the brain central structures in elaborating a new arrangement of the control system of both, the locomotorium and the motor system of the speech-formation system. Practical application of the proposed device allows for creation of the stereotype of posture  
15 and movements closely resembling the physiological one.

#### Brief Description of the Drawings

Further objects and advantages of the present invention will be understood from the following detailed description of a specific exemplary embodiment thereof  
20 and the accompanying drawings, wherein:

FIG. 1 is a front view of a device, according to the invention;

FIG. 2 is a side view of FIG. 1; and

FIG. 3 is a rear view of FIG. 1.

#### 25 Best Mode of Carrying Out the Invention

The device of the invention comprises supports 1 adapted for being mounted in the region of the patient's shoulders, elbows, hands, pelvic girdle, knees, feet, fingers, and toes. The supports 1 are interconnected  
30 through fixing elements which appear as elastic tie-members 2 adapted to interconnect both the adjacent and nonadjacent supports 1. The tie-members 2 are so connected to the supports 1 that they are arranged on the surface of the patient's body in antagonistic pairs to

follow the anatomical arrangement of the skeletal muscles. Each of the tie-members 2 has an adjuster 3 of its tension, which connects said tie-member 2 to one of the supports 1.

Each tension adjuster 3 is in fact a band 4 having one of its ends connected to the tie-member 2 and the opposite end is held to a lock 5 which in turn is fastened on one of the supports 1.

The adjuster 3 may obviously be of any other construction suitable for performing a similar function.

The supports 1 can be made of any material featuring a minimum degree of extensibility, such as fabric, leather, plastics, and so on.

Specifically, the tie-members 2 can be made of rubber, plastics, or appear as metallic springs.

The device of the invention functions as follows.

The proposed device is selected individually for every patient taking account of his/her state and size of the body. Then the device is put onto the patient and those tie-members 2 are tensioned which correct the position of the body parts to be treated. The tie-members 2 are adjusted for tension with the aid of the adjuster, whereupon the position thus attained is fixed by the locks 5. The tie-members 2 are adjusted until a new position of the trunk and limbs is reestablished, which approximates the normal physiological one and enables the patient to perform movements with an amplitude close to a maximum one for a given patient. The tension of the tie-members 2 is increased at least until a load appears in the group of muscle corresponding to a given movement. This done, the device is ready for use.

Thus, a dynamic supporting structure (functional corset) is established with the aid of the present device and the patient is prepared for performing movements.

The device is utilized by the patient with due account of his/her status and individual peculiarities daily for a period of up to 12 hours a day, a treatment cycle lasting for 15 - 30 days.

The tie-members 2 arranged on the surface of the patient's body in antagonistic pairs to follow the anatomical arrangement of the skeletal muscles with respect to the joints provide for all kinds of patient's movements in the course of practical application of the device. In the course of treatment the degree of tension of the tie-members 2 is gradually increased. As the patient becomes adapted to the correcting action of the device, the correction force is increased without affecting the sense of comfort with respect to the load applied.

A new stereotype of control of patient's movements is established in the course of treatment. In addition, the patient's physiological status becomes predominant, which results in a reduced amount of pathological muscular synergies and increased extent of motor activity and allows of correcting the patient's posture in the cases unamenable to treatment with other correction methods.

The present device can be additionally furnished with overalls put onto patient above the device. The overalls are provided with openings to provide access to the adjusters 3.

#### Example 1

Male patient B.K., 17. Diagnosis: infantile cerebral paralysis. The diagnosis has been established since the six-month age. By the time of treatment with the proposed device the patient had developed paralysis in the form of spastic diplegia. There occurred triple flexion in the lower limbs complicated by contractures in the ankle joints, internal rotation of the thighs, uncompensated body inclination forwards, difficulties in locomotion, pathologic gait; talipes equinovagum in both feet ("rocking foot"), internal rotation of both arms, and difficult movements of the hands and fingers. The patient's intellect remained unaffected, as well as phrasal

speech. There was noticed high level of psychologic motivation for therapeutic rehabilitation. Previously the patient had been treated medicinally and with the aid physiotherapy, as well as by correction with plaster bandages

5                      and solid plaster bars. However, the treatment produced but a transient effect.

The patient passed a treatment course with the proposed device for one month, by daily sessions of 2 - 3 hours.

10                      The load applied was perceived by the patient within the initial seven days of treatment after which the sensation of load disappeared and adaptation ensued. However, within the initial five days the pathological posture of the patient's trunk and limbs reappeared in two hours after load releasing. On the 10th day of treatment a stable  
15                      result of treatment occurred manifested in complete disappearance of the pathologic posture, elimination of flexural disturbances of the lower limbs, improvement in the gait pattern, facilitating forward displacement of the thighs and higher walking pace. After the 10th day  
20                      of treatment the patient could walk in the erect position. In addition, by the 10th day of treatment there were observed a considerable decreasing of the pronation disturbances in the hands and fingers. The patient was dismissed in 30 days after admission with a considerable improvement  
25                      of motor and static functions.

Given below is a table representing the clinical evidence of practical application of the proposed device in treatment of a group of patients for the late residual stage of infantile cerebral paralysis. The age range of the  
30                      patients was within 15 and 20, a total number of therapeutic sessions 16 - 22 for one month.



Table

Nos	Form of disease	Number of patients	Progress in process of rehabilitating treatment	Assessment of therapeutic effect in five-point system
1	Spastic diplegia	4	<ol style="list-style-type: none"> <li>1. Normalization (though not always complete) of principal pathological muscular synergies responsible for triple flexure of the lower limbs and flexural synergy in the upper limb. Increased pace length, correct formation of the front and rear thrusts of pace.</li> <li>2. Diminished torsion of the trunk and in the shoulder girdle. Lower intensity of frontal rocking.</li> <li>3. Disappearance of pathological synergy in the shoulder girdle. Increased manipulative abilities of the hand and fingers.</li> <li>4. Gradual improvement in the articulatory aspect of patient's speech.</li> </ol>	4-3
2	Hyperkinetic form	2	<ol style="list-style-type: none"> <li>1. Walking without support. Torsion hyperkinetic phenomena of the neck and trunk muscles still persisted.</li> <li>2. Intensity of hyperkinesis reduced after 10-15 treatment sessions. Walking over long distances became possible though without conjugate movements of the upper limbs.</li> <li>3. Improved speech which became discriminable by the patient's associates. The patient got able to perform self-care due to restored movements of the arms.</li> </ol>	4-3
3	Cerebellar	2	<ol style="list-style-type: none"> <li>1. Unassisted walking over a distance of 200-300 m, the original status being complete inability to walk.</li> <li>2. Diminished cerebellar symptoms (hypermetria, dysmetria, ataxia of the trunk and limbs).</li> <li>3. Attenuated speech scanning. Speech became discriminable.</li> </ol>	5
4	Hemiparetic form	2	<ol style="list-style-type: none"> <li>1. Improvement in motor functions.</li> <li>2. Decreased fatigue in walking; walking over long distances.</li> <li>3. Improved manipulative activities of the paretic arm.</li> </ol>	3

As can be seen from the Table, the best results of treatment with the present device were obtained with the cerebellar form of the disease, while the least effect was noted in the hemiparetic form of infantile cerebral paralysis.

Example 2

Male patient Kh., 40. Diagnosis: affection of the lumbar cord with partial disturbance of conduction (decompression sickness).

The patient passed a treatment course with the proposed device. The treatment led to improved walking parameters, i.e., synchronism in muscular activity, increased walking pace, and reduced fatigue.

Industrial Applicability

The proposed device can be used for treatment of patients affected by infantile cerebral paralysis, as well as in cerebrovascular accidents involving motor disturbances and traumatic lesions of the spinal cord.